Contributions toward a Monograph of *Petalophyllum* (Marchantiophyta)

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ABSTRACT. The simple thalloid liverwort genus *Petalophyllum* J. G. C. Lehmann is removed from the Fossombroniaceae and sequestered in the new family Petalophyllaceae along with *Sewardiella* S. R. Kashyap, a monotypic genus endemic to the Indian subcontinent. Unlike the Fossombroniaceae, the thallus in the Petalophyllaceae is never dissected, the archegonia are clustered rather than scattered, a pseudoperianth is formed rather than a caulocalyx, and the capsule wall is 3–4-layered with outer wall thickenings, which are lacking in the Fossombroniaceae. The North American representative of *Petalophyllum* previously considered conspecific with the European taxon *P. ralfsii* (W. M. Wilson) J. G. C. Lehmann is here described as a distinct species, *P. americanum*. This is based upon clear differences of the thallus, pseudoperianth, and the elater spirals. Furthermore, the application of the name *P. australis* Colenso to New Zealand plants is shown to be incorrect; those plants previously referred there represent a new species, *P. hodgsonii*. This species resembles *P. ralfsii*, but differs from it in the broad, strongly flattened thallus midrib and structure of the female inflorescence.

Key words: *Austrofossombronia*, Fossombroniaceae, liverworts, Marchantiophyta, New Zealand, North America, Petalophyllaceae, *Petalophyllum*, *Sewardiella*.

THE FAMILY PETALOPHYLLACEAE

The simple thalloid liverwort genus *Petalophyllum* C. G. D. Nees & Gottsche ex J. G. C. Lehmann (Lehmann, 1844) has been aligned with the genus *Fossombronia* Raddi since its publication. The inclusion of these two taxa and the genus *Sewardiella* S. R. Kashyap in the family Fossombroniaceae Hazlinszky has been generally unequivocal among hepaticologists, although Schuster (1953: 575) stated ". . . I would regard it [*Petalophyllum*] as a representative of a separate family, the Petalophyllaceae." This family was never validly published by him, but many years later he did segregate *Petalophyllum* and *Sewardiella* from *Fossombronia* and his recently validated genus, *Austrofossombronia* R. M. Schuster, at the subfamily rank when he named the Petalophylloideae (Schuster, 1991) within the Fossombroniaceae. The genera *Fossombronia* and *Austrofossombronia*, then, comprised the Fossombronioideae of this family.

During an ongoing monographic study of *Petalophyllum*, a number of structural and developmental features have been elucidated that justify elevation of the Petalophylloideae to the rank of family. In *Petalophyllum* the thallus is not dissected, and it develops unistratose dorsal lamellae. *Sewardiella* is composed of a very fragile unistratose thallus wing. Conversely, the thallus of all other members of the Fossombroniaceae is highly dissected, giving the plants a leafy appearance. The apical cell geometry of the Petalophyllaceae is reported as being tetrahedral in *Sewardiella* and either tetrahedral or lenticular in *Petalophyllum*, depending on the species (Leitgeb, 1877). In the Fossombroniaceae the geometry is strictly lenticular (Renzaglia, 1982). Archegonia develop in distinct clusters along the midrib in the Petalophyllaceae, not scattered along the stem or midrib as in the Fossombroniaceae. These archegonial clusters are surrounded, even in the earliest stages of development, by a unistratose pseudoperianth in the Petalophyllaceae. The pseudoperianth expands in typical fashion after fertilization to enclose the sporophyte, which is further encased by a thin shoot calyptra. In the Fossombroniaceae, the solitary, unfertilized archegonia are completely devoid of any type of enclosing structures; i.e., they are naked on the stem. After fertilization, concomitant with the early stages of embryo division, the stem tissue around the venter undergoes substantial cell division to form a fleshy enclosure around the basal part of the sporophyte. A leaf-like scale, which aris-

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es at the apex of this fleshy mound, enlarges as the sporophyte matures and forms a pseudoperianth-like enclosure. As originally concluded by Chalaud (1928), this structure is not, however, homologous to the true pseudoperianths of *Petalophyllum* and *Sewardiella* and is better termed a caulocalyx. Finally, the capsule wall in representatives of the Petalophyllaceae is 3–4-layered with cells in all layers having pigmented secondary wall thickenings. The capsule wall in *Fossombronia* is only 2-layered while that of *Austrofossombronia* is (3–)4(–5)-layered (Schuster, 1994; Crandall-Stotler et al., 1999). Regardless of the number of capsule wall layers, however, in the Fossombroniaceae the cells of the outer wall layer are always devoid of secondary wall thickenings.

Petalophyllaceae (R. M. Schuster) Stotler & Stotler-Crandall, fam. et stat. nov. Basionym: Petalophylloideae R. M. Schuster, J. Hattori Bot. Lab. 70: 148. 1991. TYPE: *Petalophyllum* J. G. C. Lehmann; type species, *P. preissii* J. G. C. Lehmann, Novarum et Minus Cognitarum Stirpium Pugillus 8: 30. 1844.

A New Species of *Petalophyllum* from North America

When encountered in the field, *Petalophyllum* is a conspicuously distinct simple thalloid liverwort not easily confused with other hepatic taxa. Because of its patchy occurrence, however, it is not frequently observed. The first report of the genus in North America was by Evans (1919), who identified two Texas specimens as *Petalophyllum ralfsii* (W. M. Wilson) C. G. D. Nees & Gottsche ex J. G. C. Lehmann, the "petal wort" common in the British Isles and the Mediterranean region. Since then, scattered reports can be found in the North American literature under that name or as *P. lamellatum* (C. G. D. Nees) S. O. Lindberg, a taxonomic synonym of *P. ralfsii* (Lindberg, 1874). Careful evaluation of the type specimen of *P. ralfsii* (= *Jungermannia ralfsii* W. M. Wilson), near Penzance, *Ralfs s.n.* (BM), and of European populations of this species have revealed several distinctions between this taxon and the North American populations of the genus. These morphological differences warrant the recognition of the North American populations as a new species, which may be contrasted with *P. ralfsii* by several distinguishing characters. Vegetatively, in North American plants both the wing and lamellar margins are entire, very rarely sinuate. In *P. ralfsii*, both the wing and lamellar margins are sinuate. Mature pseudoperianths in the North American plants are small, barely projecting above the lamellae, and unlobed, with the mouth margin being sinuate to dentate, but never ciliate. These features may be clearly seen in Schuster's (1992: 428) figure 849-1 from Texas plants. In *P. ralfsii*, the pseudoperianth is much larger and sometimes deeply lobed with the mouth margin always strongly toothed to ciliated or even laciniate. The elaters in both species are bi-spiraled (tri-spiraled) at their tips, but in our North American plants 2 to 4 (occasionally 5 or 6) spirals are found through most of the elater length. There are never more than 2 or 3 spirals formed in *P. ralfsii*. In North America, *Petalophyllum* has been confirmed from Arkansas, Louisiana, and Texas, where it often occupies recently disturbed areas of well-drained sandy soils that are generally exposed. In the British Isles, in contrast, it is typically found in stabilized sand dunes. Thus, these two species appear also to occupy very different habitats.

Petalophyllum americanum C. H. Ford & Stotler-Crandall, sp. nov. TYPE: U.S.A. Texas: Bastrop Co., Bueschner State Park, on red soil in moist depression, 13 Mar. 1997, *R. E. Stotler & B. J. Crandall-Stotler 4006* (holotype, ABSH; isotype, as dupl. in FAA).

Differt a *Petalophyllo ralfsii* marginibus thalli et lamellarum integris, ore pseudoperianthii sinuato-dentato, elateribus spiris 2–4(5–6).

Populations light green, occurring as isolated individuals or in small scattered patches on exposed, loose or somewhat firm gravely or sandy loam. Plants 3.9–11.2 mm long, 2.7–8 mm wide, simple or once (twice) furcate. Thallus elliptical to obovate, broadly undulate, with the wings lamelliferous. Wings flattened to erect, multistratose at the base, becoming unistratose at the margin, with the margin plane; the median thallus cells thin-walled, quadrate to elongate, averaging 68 × 41.2 μm, with the marginal cells distinct, tangentially elongate or quadrate, 36.1–39.9 μm long, 34.2–43.7 μm wide. Lamellae leaf-like, erect to suberect, running obliquely along the thallus wings, unistratose, multistratose at the base, up to 22 cells in height at the highest point, slightly undulate, with the lamellar margin plane; the marginal cells distinct, quadrate to tangentially elongate, averaging 36.3 × 43.5 μm. Midrib fleshy, with the dorsal surface flattened to slightly concave, with the ventral surface narrowly convex. Tubers apical, from microphyllous, geotropic apices. Rhizoids numerous, scattered along the ventral surface of the stem, hyaline. Dioicous, dimorphic. Male plants somewhat smaller

than female plants. Antheridia maturing acropetally, in 2 or 3 scattered rows along the dorsal surface of the midrib and associated with the basal portion of the wings, overarched basipetally by lobed marginal extensions of the lamellae. Female plants with 5 to 9 archegonia in distinct clusters on the dorsal surface of the midrib, with each cluster surrounded by a pseudoperianth. Pseudoperianths at maturity campanulate, 1(2) medially positioned along the midrib, with the outer surface occasionally bearing leaf-like outgrowths; the mouth erect or recurved, with the margin broadly sinuate and dentate to subdentate, cilia lacking, with 1(2) sporophyte(s) maturing per pseudoperianth. Capsules spheroidal, 1.4–2.3 mm diam., dark olive brown to black; the epidermal cells quadrate, light yellow with scattered dark red-brown nodular thickenings; the cells of the inner layers gradating from quadrate to elongate, with dark red-brown thickening bands gradating from nodular to semiannular to annular, dehiscence irregular. Spores 40–52 μm diam., light brown to dark red-brown, disassociated when mature, areolate, with (4)5 or 6 areolae across the distal face; the areolae 10–12 μm wide; the proximal surface areolate, with a central depression. Elaters numerous, smooth, elongate, rarely to occasionally branched, with the outer wall light yellow, smooth, with 2 to 4 (occasionally 5 or 6) dark red-brown spirals. Gemmae absent.

Habitat. Exposed, compact or loose, sandy or gravely soil, often in disturbed areas, or near temporary ponds.

Distribution. Scattered locations in the Gulf Coastal Plain of North America, extending into the southern portion of the Interior Highlands; from southern Arkansas to southern Louisiana west to east and central Texas.

Paratypes. U.S.A. **Texas:** Bastrop Co., Bastrop State Park, well-drained sandy soil along roadside, 12 Mar. 1997, *Stotler & Stotler-Crandall 3980* (ABSH; dupl. in FAA); nr. Bueschner State Park, well-drained sandy soil, corner of CR 180 & Park Road 1C, 13 Mar. 1997, *Stotler & Stotler-Crandall 3998* (ABSH; dupl in FAA); Bueschner State Park, wet seep area under grass clumps, 13 Mar. 1997, *Stotler & Stotler-Crandall 4003* (MO; dupl. in FAA at ABSH).

A New Species of *Petalophyllum* from New Zealand

During the late 1800s, the Reverend William Colenso described two New Zealand species of *Petalophyllum*, namely *P. australe* Colenso as "*australis*" (Colenso, 1885) and *P. macrocalyx* Colenso (Colenso, 1886). No specimens of these two species have been located in the intervening years by any hepaticologist: not in WELT, which contains many of Colenso's types, nor in BM, which holds numerous of his bryophyte types that he had sent to Hooker (Galloway, pers. comm.), nor in G, where he sent specimens to Stephani. In a revision of Colenso's Hepaticae by Stephani (1893) neither of these two species was mentioned, but Stephani did state that there were other Colenso species published of which he had not received specimens. Hodgson (1967) appears to be the first to recognize the publication of these two Colenso species. She realized that several New Zealand specimens of *Petalophyllum* that she had studied were not assignable to *P. preissii*, a species described from Australia. She revived the oldest Colenso name, *P. australe*, to accommodate these and apparently in order to deal with the name *P. macrocalyx*, simply listed it as a synonym. This, of course, is contrary to nomenclatural rules. She stated that she had ". . . adopted Colenso's name for this species because Gottsche's description of *P. preissii* . . . does not quite fit New Zealand plants" (Hodgson, 1967: 192). Our initial hope was to designate one of the Hodgson specimens as a neotype for *P. australe*, but this was not possible since none of that material conformed to the protologue. The Hodgson plants are clearly not what Colenso had described as *P. australe*; rather, his description of plants with large, much lacinate pseudoperianths fits *P. preissii* fairly well. Nor can the Hodgson specimens be *P. macrocalyx*, which Colenso described as being small plants with leaves and red rhizoids. That description, in fact, fits a member of the genus *Fossombronia* rather than *Petalophyllum*. We found that the Hodgson material represents an undescribed species of the genus distinguished from all other species of *Petalophyllum* by a suite of diagnostic characters. It is here named in honor of E. Amy Hodgson, the amateur botanist who laid the foundation for modern New Zealand hepaticology.

Petalophyllum hodgsonii C. H. Ford & Stotler-Crandall, sp. nov. TYPE: New Zealand. North Island: Morere Bush, Wairoa, on bank along path to baths, Sep. 1947, *E. A. Hodgson 11297* (holotype, MPN).

Magnitudine *Petalophyllum ralfsii* simulans, differt a *P. ralfsii* costa lata complanata, archegoniis pigmentiferis, ore pseudoperianthii sinuato vel dentato, sine ciliis.

Populations not observed in nature; herbarium specimens light yellow green, occurring as isolated individuals, loose mats or in scattered small patches on sand and humus. Plants large, 9.5–13.3 mm long, 6.6–10.2 mm wide, often (once) twice or more

furcate. Thallus elliptic to ovate, slightly to highly undulate, with the wings lamelliferous. Wings flattened to suberect, multistratose at the base, becoming unistratose at the margin, with the margin broadly sinuate; the median cells thin-walled, quadrate to elongate, with the marginal cells slightly distinct, quadrate to slightly tangentially elongate, 28.9–53.2 μm long by 24.7–55.1 μm wide. Lamellae leaf-like, suberect to erect, running obliquely along the thallus wings, tapering to or almost to the thallus wing margins, unistratose, multistratose at the base, up to 20 cells in height at the highest point, slightly to highly undulate. Midrib broad and fleshy, with the dorsal surface slightly compressed, with the ventral surface strongly flattened. Tubers 0(1), apical, from microphyllous, geotropic apices. Rhizoids numerous, scattered along the ventral surface of the stem, hyaline. ?Dioicous. Male plants not observed. Female plants with 8 to 15 dark red or unpigmented archegonia in distinct clusters along the dorsal surface of the midrib, with each cluster surrounded by a pseudoperianth. Pseudoperianth at maturity subcampanulate, 1 to 3 terminal or medially positioned along the midrib, with the outer surface lacking wings or leaf-like outgrowths; the mouth erect to incurved or recurved, with the margin undulate, dentate to sinuate, lacking cilia, with 1 sporophyte maturing per pseudoperianth. Capsules brown-black; the epidermal cells quadrate, light yellow with scattered dark red-brown nodular thickenings, with the cells of the inner layers gradating from quadrate to elongate, with dark red-brown nodular wall thickenings gradating from semiannular to annular, dehiscence irregular. Spores 39.9–51.3 μm diam., brown, disassociated when mature, areolate, with 3 or 4 areolae across the distal face, with the areolae 9–10 μm across; the proximal surface areolate, with a central depression. Elaters abundant, elongate, rarely to occasionally branched, attenuate, with the outer wall light yellow, smooth, with 2 or 3 red-brown spirals. Gemmae absent.

Habitat. Along stream banks among ferns and humus.

Distribution. New Zealand.

Acknowledgments. This work was supported by NSF–PEET grant DEB-9521883, which is gratefully acknowledged. We thank the following, who provided living plant material: James Bray, Tim Golden, Jered Kyzer, Daniel Marsh, and Daniel Wrench. We gratefully acknowledge Tim Galloway (WELT) and Ella Campbell (MPN) for their comments concerning the activities of William Colenso, and we thank David Glenny (CHR) for his assistance in locating critical specimens and place names. The authors sincerely thank L. Ellis (BM) and the late P. Geissler (G) for providing study facilities at their respective institutions. We thank the following for arranging the loan of specimens: L. Ellis (BM), P. Heenan (CHR), the late P. Geissler (G), L. Dixon (MPN), and T. Galloway (WELT).

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